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GUIDELINES FOR REDUCING THE EFFECTS OF FOMES ANNOSUS IN TRUE FIR IN STANDS MANAGED FOR TIMBER

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ABSTRACT

Annosus root disease, caused by Fomes annosus, is a damaging agent of true firs in many forest stands throughout California. The difficulty of detecting it and its persistence on the site have made it a management concern in many situations. The development of specific management strategies must be made for each site and situation. This paper presents guidelines and activities that are available for use in developing such management strategies.

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INTRODUCTION

Fomes annosus, the cause of annosus root disease, is often found infecting white and red firs in the mixed conifer and true fir forests of California. In a recent survey, almost 20% of the recently dead true firs and 1-1/2% of live true firs were estimated to be infected.[1/]

Fomes annosus infects primarily the heartwood of roots and butts of true firs. The two known entry courts for the fungus are basal wounds and stumps. Spores, the infective propagules, are produced by conks that are found mainly in decayed stumps and on roots of windthrown trees. Seasonal trends in spore dispersal and deposition vary with climatic characteristics of the area. In warmer, drier areas with relatively low amounts of snow, deposition peaks during the winter months. In cooler, more moist areas where snow depth may be several feet, deposition is highest in autumn. Low numbers of spores are released year-round. Following summer rains, large numbers of spores may be released for short periods.

Once established in a true fir, the fungus grows through the roots and decays the wood. Where root contacts occur, the fungus will invade and infect the healthy root. By this means, F. annosus produces expanding centers or pockets of activity in true fir. These centers are usually recognized by the presence of old snags, windthrown trees, dead and declining trees, and old stumps. Centers continue to expand until spread of the fungus is limited by the lack of additional host roots. Observations would indicate, though, that other unexplained factors may also limit underground spread.

Annosus root disease can affect true firs in several ways. Infection can cause direct mortality. This is most common in trees sapling-size and smaller. Larger trees also can die as a result of infection, but this oftentimes involves successful attack by the fir engraver, Scolytus ventralis. Mortality of larger trees also occurs because of windthrow that results from severely decayed and weakened root systems. A less catastrophic effect of annosus root disease in larger trees is the volume loss from butt rot. Fomes annosus persists in infected trees and stumps for many years, up to decades, and can continue to infect healthy trees. This persistence can limit the productivity of the infested area as the fungus continues to kill regeneration of true firs.

The number of requests received by FPM for technical assistance from resource personnel managing true fir forests infested by F. annosus has been increasing in recent years. This has indicated the need for the formulation of management guidelines that will aid in reducing the

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1/ DeNitto, G.A., J.R. Parmeter, Jr., G. Slaughter, and M. Schultz. 1984. Incidence of Fomes annosus in mixed conifer and true fir forests in northern California. USDA For. Serv., Forest Pest Mgmt. Rep. No. 84-11. 12 p. Pacific Southwest Region, San Francisco, CA.

effects of F. annosus. The guidelines presented below attempt to address this need. They were developed to answer some of the questions about annosus root disease in true fir, utilizing our present state of knowledge. Most of them are based on observations from work with other hosts and locations. As additional information is gained, refinements and changes may be necessary.

The particular guidelines selected at any place will depend on the specific site and stand characteristics and on management constraints on the area. Individual guidelines that are selected may need to be further modified and adapted to the particular stand. Depending on the complexity of the situation, Forests and Districts may need to request stand-specific information from Forest Pest Management. FPM can provide assistance on-the-ground and work with the local resource manager to formulate appropriate management strategies.

MANAGEMENT GUIDELINES

1. Avoid Damaging the Cambium.

A. Logging injury.

Basal wounds are an entry court for the fungus. Fomes annosus has been isolated from wounded true firs and the fungus is known to infect wounds of other host species. Methods have been developed that will reduce the number of trees wounded from logging operations.[1/] This includes timing of the operation, skid trail layout, leave tree marking, regulating equipment size, directional falling, limbing and topping, log length skidding, and improved sales administration. Following the sale, any wounded trees should be removed.

B. Underburning.

Increased fuel loads are increasing the need and demand for underburning. Special care must be taken in true fir and mixed conifer stands to minimize basal scarring. Rapid, low-temperature fires that are performed before fuel loads are too heavy may reduce the damage. Other methods that will minimize the temperature of the fire, while attaining fuels reduction, will decrease wounding. Fire should be used sparingly in young, thin-barked stands because of the increased likelihood of wounding and infection by F. annosus.

[1/] Aho, P.E., G. Fiddler, and M. Srago. 1983. Logging damage in thinned young-growth true fir stands in California and recommendations for prevention. USDA Forest Service, Res. Pap. PNW-304. 8 p. Pacific Northwest Forest and Range Experiment Station, Portland, OR.

2. Reduce the Number of Entries.

Generally, the fewer times that a stand is entered, the less basal wounding that occurs. Less wounding reduces the opportunity for infection by decay organisms, including F. annosus. Therefore, silvicultural prescriptions that minimize the number of entries will minimize the probability of root disease.

The activity prescribed depends on stand characteristics, including the life stage. During regeneration, planting fewer seedlings at an increased spacing will delay the time until the first entry. This requires successful planting and increased control of competing vegetation. A heavier precommercial thinning of sapling and pole-size stands can postpone the first commercial entry. The small-diameter stumps produced in a precommercial thinning have less chance of successful infection or will not carry the fungus any distance compared to the larger stumps from a commercial entry. In a commercial stand, fewer, but heavier cuts during commercial thinnings will reduce the need to reenter the stand as frequently. The increased spacing of leave trees may also reduce the amount of logging damage. Opening the stand too much, however, may result in release shock, sunscald, and windthrow.

3. Shorten Rotation.

Reducing the time true firs are on an infested site will limit the opportunity for root exposure to annosus root disease. This is expected because of the reduced development of the root system and the decreased time for the fungus to grow through roots of infected trees and stumps. Reduced root exposure to infection will limit the number of trees infected and limit the underground spread of the fungus. The smaller root and stump systems of younger trees will also result in faster replacement of F. annosus by other organisms and possibly more rapid dieout of active root disease centers. It is not known how shorter rotations will affect ~~subsequent~~ regeneration of true firs and the effects of F. annosus.

4. Promote a Mixed Species Stand.

During any entry, favoring pines, Douglas-fir, and hardwoods will aid in reducing future impact of F. annosus in true fir. However, if pines in the stand are also infected by F. annosus, the benefit may be reduced or lost. Several reasons exist for the potential reduction of impact. First, there will be fewer firs available that could be affected. Second, pines intermixed with infected true firs usually do not become infected. Some evidence of host specialization in the fungus has been accumulating. Third, the non-fir root systems will tend to act as barriers to underground spread of the fungus between fir root systems, thereby restricting the size of annosus root disease centers. Fourth, a mixed species stand will reduce the effects of other host-specific pests such as dwarf mistletoe.

5. Regenerate with Other Species.

In stands experiencing unacceptable losses, maintenance of true firs may not be a viable alternative because of lowered productivity of the site. It may be advisable to remove the existing firs and regenerate the area with pines or Douglas-fir. Some reduction in productivity would have to be accepted with the introduction of a species less suited to the site than true firs. However, by the completion of the rotation the fungus should have died out on the site and true firs could be reintroduced.

6. Minimize Stress.

Fomes annosus infects a large number of live true firs, decaying the heartwood of the butt and major roots of individual trees. This type of decay does not result in rapid mortality of trees. Instead it stresses trees and results in decline and eventual mortality, usually from attack by the fir engraver. The rapidity with which this decline and insect attack occurs is increased when other stresses are acting on the tree. Such factors as drought, overstocking, off-site management, and other pests, such as dwarf and true mistletoes, can supplement the stress resulting from root disease.

True firs infected by F. annosus may be able to tolerate infection if other stresses or their effects are minimized. In general, maintaining vigorous growth of true firs may reduce losses to annosus root disease in infested stands. The hypothesis is that this will promote root regeneration faster than the fungus kills roots. Attaining vigorous growth can be accomplished by maintaining proper stocking levels and avoiding the management of true firs on sites better suited to other tree species. The effects of other pests must also be minimized. This is especially important for dwarf and true mistletoes, Arceuthobium abietinum and Phoradendron bolleanum ssp. pauciflorum, respectively. Actions that can reduce the effects of dwarf mistletoe include selecting against heavily infected trees during thinning, removing infected overstory trees, protecting uninfested stands from infection from surrounding stands, and maintaining stocking at levels that sustain annual height growth of one foot or more.

In addition to the above practices, infested stands may need to be harvested prior to the end of the normal rotation if growth slows and losses increase.

7. Treat Stumps with Borax.

This type of treatment is widely used during the thinning and harvesting of resinous species. It is also required on all freshly cut conifer stumps, including true fir, in developed recreation areas (see FSM 2305 and 2331.3, R-5 Supplement No. 90). It has been demonstrated that the application of borax (sodium tetraborate decahydrate) to freshly cut white fir stumps does reduce infection. The efficacy on red fir stumps is expected to be similar. This chemical has been registered by the EPA (Reg. No. 1624-94) for such use in California and Nevada.

The efficacy of borax treatment in reducing losses of true fir is uncertain for two reasons. Although freshly produced stumps are a principal means of entry by the fungus into a stand, other means, such as through wounded roots or tree boles, may be significant. Treatment of stumps, however, would reduce the number of new infections in areas where spores of the fungus are present. Second, the extent of F. annosus in infected true fir stands cannot be readily determined because of the lack of above-ground symptoms in living true fir. The amount of F. annosus in a stand may already be at a level that the effects of additional infections would not justify the expense of treatment. Many of the trees may be infected prior to felling, making borax treatment ineffective.

A project to evaluate the efficacy of borax treatment in thinned true fir stands is underway. The effectiveness of treatment will take several years to determine. Until this question is answered, it is recommended that assistance from Forest Pest Management be obtained for specific stands if borax stump treatment is considered.

8. Reduce the Amount of Inoculum.

Reducing the amount of infected stump and root tissue in the soil has the potential to limit underground spread of the fungus, reduce infection of regeneration, and decrease the time the disease is active on the site. Stump removal during site preparation would reduce the amount of inoculum substantially. Deep discing following stump removal would break up many of the major roots, thereby exposing them to more rapid occupation by organisms competitive with F. annosus and decreasing the hazard from the disease.

Neither of these techniques has been tried operationally in California forests. Similar attempts have been made with other root diseases in other parts of the world. Generally, there is a reduction in damage following such activities. The amount of soil disruption and the intensity of treatment would appear to limit the applicability of these techniques in California. Because of the limited knowledge available, resource personnel contemplating these treatments should contact Forest Pest Management for site-specific assistance.